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THE VALE OF KASHMIR.

BY

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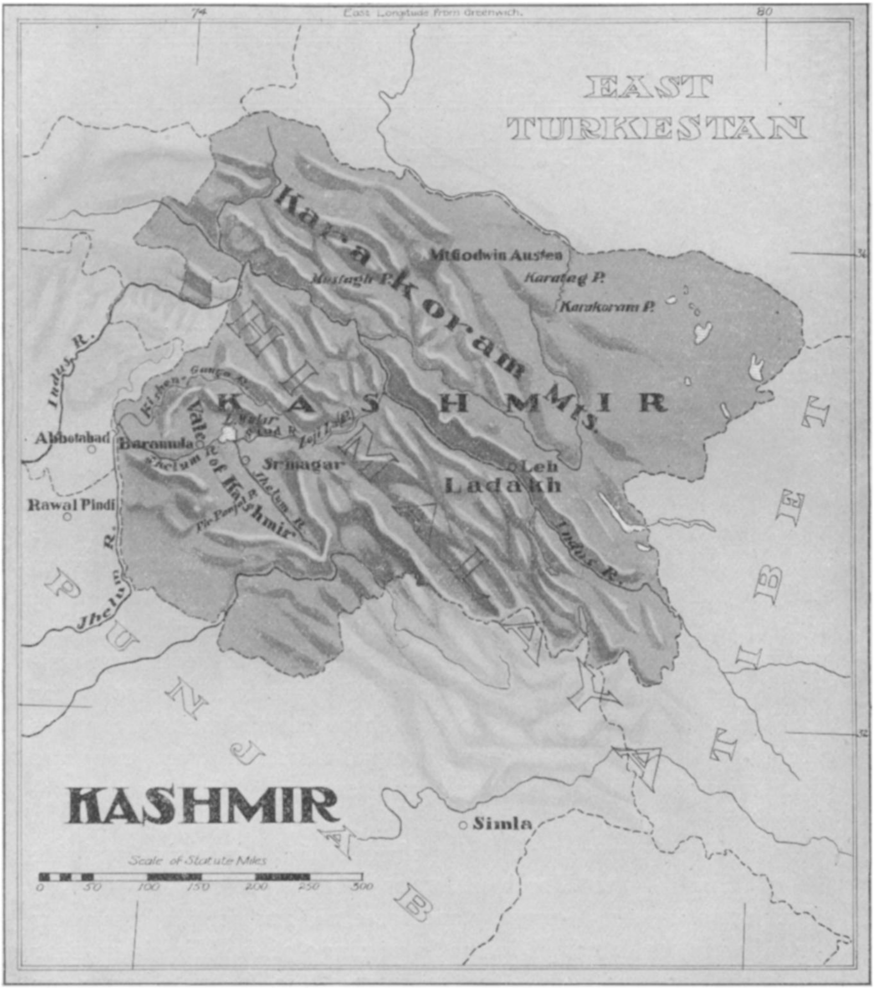
PART I.—THE GEOGRAPHY OF TO-DAY.

The BULLETIN for January, 1905, contained a preliminary notice of the expedition of Mr. Robert L. Barrett *via* India to Chinese Turkestan,—and expedition in which he was accompanied by the author. Our chief objects, as then stated, were the study of "the history of the basins of Central Asia during recent geologic times, and the changes which have taken place since the occupation of the country by man," together with "investigations of the relation of physiography to life, and especially to human life and history." The first subject of serious study was the famous Vale of Kashmir, in the Himalayas, which, with the neighbouring and contrasted region of Ladakh, presents an unusually attractive field to the student of the influence of physical environment upon human habits and character. It also offers some most interesting suggestions as to the possibility that changes of climate during historic times have had a marked effect upon the distribution and habits of man, and hence upon his history and character.

On leaving the warm, low plains of northern India, a six-days' ride (from March 13 to March 18, 1905), in two-story, two-wheeled ekkas, or native carts drawn by one horse, took us north across a low pass about 5,000 feet high in the front range of the Himalayas near Abbottabad and east up part of the gorge of the Jhelum River to the basin of Kashmir. Our first view of the famous valley-plain from a spur a thousand feet above the river was disappointing. Low-lying masses of heavy clouds half hid the lofty encircling ranges of snow-capped mountains; while from the base of the latter flat-topped tongues of piedmont gravel, the tabular remnants of an older, deeper filling of the basin floor, sloped gently down on either side to a point where they were sharply cut off by low river bluffs. Between the latter a water-logged plain of ploughed or stubble fields expanded to a width of ten or fifteen miles and extended indefinitely to the southeast. A large lake to the north, occasional smaller expanses of leaden water, and a dark-brown river flowing in a serpentine course from southeast to northwest completed the view. It was interesting but not beautiful, and hence was disappointing. The tops of the magnificent snowy mountains, rising to heights of 15,000 to 18,000 feet on every side of the plain, were wholly concealed



by clouds, and the verdure for which the vale is renowned had not yet appeared. Northeastward from our hilltop the plain soon came to an end where the front range widens and joins the more northeasterly main range; but to the southeast it stretched away ninety miles towards the head waters of the Jhelum, where the two ranges again join, after separating to a distance of nearly fifty miles from one snowy crest to the other.

The Jhelum River, after meandering northwestward through most of the plain, enters the shallow lake of Wular, twelve miles in diameter, at the base of the northern range, and then, on its exit, turning southwest, flows ten miles to the foot of our spur, where it enters the front range at Baramula. At first, in its course through the latter, it runs forty miles westward diagonally across the northern foothills of the front range, and then thirty miles northwestward along the base of the latter in a deep, picturesque mountain valley broad enough to allow a road and a few villages at its base. At the mouth of the Kishen-Ganga River, however, which comes down southwestward from the lofty main range, the Jhelum suddenly turns south, and for fifty miles flows transversely across the front range in a gorge so deep and narrow that the famous Murree road is obliged to leave it and climb 5,000 feet over a pass in order to reach Rawal Pindi, a few miles west of the point where the river emerges on the main southern plain. The Jhelum, like the Indus, seems to be an example of a river which has preserved its course unchanged since some far past time when the country was much flatter than at present. Now, however, it has sawed its way deep into the heart of a strip of country fifty miles wide and hundreds long which has been warped up along its course, forming the front range of the Himalayas between the elevated basin plain of Kashmir to the northeast and the low plain of the Punjab to the southwest.

As we descended from our hilltop and reached the brown grassy slope half a mile from Baramula, five or six men, armed with portfolios, converged threateningly upon us. One, suggesting a policeman, brandished an official-looking document; a second waved a photograph; a third held a drawing like the plan of a steamer; and the others carried open letters. They all thrust their papers into our unwilling hands, and, in the broken English now spoken by many natives of Kashmir, shouted in rivalry, "Master! master! read this!" "This my boat; very best boat. Twenty rupee." I got best boat. I am six men." "Come, master, see my boat!" In spite of protests, they escorted us to the village, helped us through the mud six inches deep, led us between the two-story wooden houses with their pyramidal thatched roofs green with grass, and brought us to the collection of houseboats on the muddy river. We thought of the jolting of our carts, and of what would await us when we left them at Srinagar, the capital, either a poor and expensive hotel or its alternative, a wet camp with no proper servants, and speedily yielded ignominiously to our captors. We engaged Subhana Benares, who claimed to be six men, together with his father, four brothers, a sister, two wives of some of the family, a modest houseboat with four small rooms roofed with reed-matting, a smaller kitchen-boat where the natives were to live and cook, and a rowboat, for all of which, including people and boats, we were to pay thirty-five rupees (eleven dollars and twenty cents) per month. Other expenses were correspondingly low, even though Subhana considered it necessary for his two "Sahibs" to have five or six pounds of "soup-meat" per day and other articles in corresponding amounts. We noticed that there was much to "throw away," and that our retainers seemed to be very well fed. Nevertheless, our seventeen days in a houseboat proved economical, though also, I regret to say, rather cold and uncomfortable, because of the time of year.

The first view of Kashmir from the Baramula spur and the experience with the houseboat impressed upon us many of the most salient features of the country. First among these is its isolation from the rest of the world by a ring of lofty mountains, unbroken except by the narrow gorge of the Jhelum; next, its great elevation of 5,000 feet and consequent comparatively cool climate, warm and damp from June to August, though but little rain falls, mild and delightful in April, May, September and October, and cold and snowy in winter, so as to be not only bracing but at times rigorous. The nature of the climate gives rise to another characteristic feature—namely, a superabundant water supply, derived partly from a precipitation of about twenty-five inches, mostly snow, on the plain, and much more from the heavier snow-fall and summer rains of the surrounding mountains. The smooth plain of fine rich soil, easily cultivated and easily flooded, presents another salient feature—one which owes its origin to the character of Kashmir as a basin deeply floored with fluvial deposits. A fifth feature is the beautiful scenery of the snow-capped mountains and green lower regions, which, combined with the temperate climate, makes Kashmir the most attractive of summer resorts for the people of India, chiefly the English; lastly, numerous terraces and deposits of gravel indicate that the region has been subject to varying climatic conditions in the not far distant past. Each of these features meets with its appropriate ontographic response in the habits and character of the people. Some of the more interesting responses will be considered in this article; but a much larger number must be left untouched, for the study of geography as the science of the relation between earth and life is as yet so undeveloped that many, perhaps most, of the responses of living creatures to their environment have not yet been correlated with the physical features to which they owe their origin.

Kashmir presents one of the best opportunities for the study of the relation of man to his surroundings, for from the earliest-known times the basin has been occupied by a single race. The people are Aryans allied to those of northern India in blood and language, but far less subject to outside influences because of the high mountain barrier, which has not only made invasion a rare occurrence but has restricted external trade and migration. Hence they have been largely left to work out their own destiny in response to whatever racial characteristics they originally brought with them, modified by the influence of religion and other introduced ideas on the one hand, and of physical environment on the other. Three religions have prevailed successively—Buddhism, Brahmanism, and Mohammedanism—each of which has doubtless had its effect. Nevertheless, according to Stein, the chief authority on the history of Kashmir, the character of the mass of the people seems to have changed but little since the Buddhist days thirteen centuries ago, when the keen Chinese pilgrim Hiuen Tsiang described the Kashmiris as "light and frivolous, and of a week, pusillanimous disposition; handsome in appearance, but given to cunning; fond of learning, and well instructed."

In response to the height and difficulty of the passes across the mountain border of his plain, the Kashmiri has not only been comparatively little troubled by the visits of either enemies or friends, but has rarely gone away from home, either for war, trade, or settlement. The result, as several writers have pointed out, is that he is cowardly, exclusive, and suspicious. Till lately he has hated and feared the few foreigners whom he has seen, and has suspected them of designing evil against himself; and, naturally, has tried to keep them out. The cowardice of the Kashmiri outside Kashmir is proverbial, and at home it is laughable. Several times in the street when I met men and unexpectedly turned on them or asked them questions, no matter how mildly, they started and trembled as though threatened with a pistol; and this is said to be a common occurrence. Mr. C. E. Biscoe, head of the large schools of the Church Missionary Society, which even the natives generally recognize as the best in Kashmir both as to education and as to character-building, told me that when compulsory exercise was first introduced, the boys, chiefly Brahmins, with a lesser number of Mohammedans, were abjectly afraid of the water, though they had lived beside it all their lives. In order to make them learn to swim it was necessary simply to throw them into the canals. Now, however, they have learned to do fine work both in and on the water, and during the last great flood, which half submerged Srinagar, saved much property and some lives. To be sure, they are still cowardly; but there has begun to be a school spirit which makes them ashamed to show their fears. Similarly, in football the boys at first ran away from one another; but now many of them stand up pluckily and run the risk of getting hurt, which shows that though isolation may have made the Kashmiris cowardly, they have a certain amount of moral fibre capable of cultivation.

Exclusiveness was carried so far in Kashmir in the Middle Ages that practically all foreigners were kept out, just as has more recently been the case in Tibet, perhaps for similar physical reasons. Even to-day, in spite of the incorporation of Kashmir in the British Empire, the old ideas prevail so far that no foreigner can remain in the Vale without a permit—renewed, I believe, annually; nor can a foreigner buy or build a house or own land. Natives, or the native Government, build to order. That is one reason why houseboats are so common; for in a boat not only does the landlord become one's servant, but one can move about freely. To people who are on the outside and want to get in, the seclusion of Kashmir seems a bad quality; but it has at least one advantage. Drew* relates how, on the Pir Panjal pass, to the south of Kashmir, at an elevation of 11,400 feet, he "found the ground and the snow for two or three miles' distance strewn with dead locusts [a pest on the plains to the south], which about the middle of May had been destroyed by the cold in an attempted invasion of Kashmir."

The climate of Kashmir is comparable in some respects to that of the northeastern part of the United States, although the sun is hotter, because of the more southerly latitude; the summers are more trying, because the heat is more rarely interrupted by showers and cool storms; and snow falls earlier in the autumn, because of the great altitude, so that the crops are sometimes ruined by it. The first day of our stay in Kashmir (March 19) was warm and clear. Our boat was being towed slowly eastward up the river by the boys and girls of our native family, who trudged barefoot along the towpath at the rate of less than two miles an hour. A stroll on shore in the bright sun among thatched houses surrounded by orchards or beside broad pools, with glimpses of hunters shooting waterfowl with huge blunderbusses, and a clear view of the wonderful ellipse of snowy mountains encircling the plain, made us realize that Kashmir can be idyllic. Most of our twenty-two days in the basin, however, were cold and raw, with several frosts and a little snow, so that we sympathised with the natives who went about with "gungris" under their long, dirty, white cotton gowns. The "gungri" resembles a large flower-pot made inside a wicker basket, with a protective wicker handle, like the arches of a half dome. When filled with live coals it serves to warm the hands—or, oftener, the whole body—by being put under the loose outer robe of either man or woman and held over the stomach whether the people are walking or sitting. It is essentially a lazy man's device; for no one can hold it and work, and it reflects the habits of the Kashmiri, especially of the farmer, who in the snow and mud of winter has nothing to do.

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*Jummoo and Kashmir, p. 158.

The abundance of the water supply of Kashmir and the smoothness and softness of the fine-soiled plain have led to the formation of an intricate network of deep, slow-moving waterways, partly natural and partly artificial, difficult to ford but easy to navigate, and often overflowing. Hence, as Stein points out, the roads are very bad; and as outside traffic is largely shut out by the mountains, beasts of burden are rare, wheeled vehicles are practically confined to the single new thoroughfare down the Jhelum, and traffic is carried on in boats, the loads being usually carried for short distances on men's backs. Almost every village is said to have its landing-place, either close at hand or a mile or two away; and in Srinagar the crowded river and the larger canals are the main thoroughfares.

Another effect of the abundant water and fine-soiled plain, together with the hot summer sun, is great fertility, causing food to be plentiful and cheap. Rice is naturally the chief crop; and though other grains grow well, they are of secondary importance. The water-chestnut, shaped like a pair of stocky cows' horns and dredged from the bottoms of the streams; many kinds of greens and vegetables, of which great quantities are eaten; and fruit, especially apples and pears, are other profitable crops. Cheap food may be a blessing, but in Kashmir one is inclined to doubt it. It seems as though the ease with which a living can be made were the chief cause of the reputed idleness and laziness of the people; and laziness, aided, perhaps, by the opportunities for dishonesty afforded by the large amount of local traffic and barter which the abundant waterways foster, may be responsible for much of the untrustworthiness which is said to be so prominent a trait of the Kashmiris. In this respect the latter are like the people of many parts of India; though they are not so lazy, perhaps, by reason of the invigorating winter climate of their mountain home.

Our own life during the two weeks which we spent in Srinagar in our house-boat was a direct response to the abundance of water, the smooth plain, the fertility of the soil, and the consequent cheapness of the necessaries of life. Like most travellers to Kashmir, we lived in a leisurely fashion. The snow on the passes delayed our start across the mountains, and the slowness of the people prevented haste of any sort. We enjoyed the quaint wood or brick houses, with their green grassy roofs, the orientalism of the narrow, dirty streets, and the busy life of the pleasanter canals. We went sight-seeing in our own "shakari," or flat-bottomed boat, with three or four oarsmen. Brahmins squatted naked on frosty mornings while they bathed at the foot of steps leading to little temples with high, top-heavy silvered domes; market women passed down the canal with boat-loads of spinach and turnips from the floating gardens in the Dal Lake, mere rafts of water-plants strewn with a little earth; merry children in twos or threes sang musically at the tops of their voices; and men clothed in dirty white walked briskly along the embankments beside the canals under the fine bur-covered chenar trees just as old Hiuen Tsiang reports them to have done long ago. Except for the fast walking—fast compared to that of India—the general appearance was leisurely. The Kashmiris, as has been said, have a reputation for laziness; but when I watched them working they seemed to show a good deal of energy and steadiness, though perhaps it was only to keep warm. Along the canal where we anchored, at least a dozen houseboats were being built for the accommodation of summer visitors, and all the timber was sawed into planks on the spot by hand. The men who worked the big saws, one at either end, kept at work steadily, though the labour is tiresome, and twice during ten minutes I noticed that when one of a pair had to stop for something his comrade went and helped some one else.

Within the last few decades a new factor has entered into the geographic development of Kashmir—namely, the attraction exercised by its climate and scenery upon the British sojourners in India. The æsthetic element of love of scenery and the rational element of choosing a place for a home for the sake of its favourable climate, though strictly geographic factors, exist only in highly-civilized communities. Therefore, in the past they have been of small importance; but as their significance is more and more appreciated, it is probable that they will exert a growing and even a preponderating influence upon the distribution of intelligent people in countries not blessed in general with the invigorating climate of the cool Temperate Zone. To-day, for instance, India is governed from the small hill-station of Simla rather than from hot Calcutta; and retired Indian officers and civil servants who cannot return to England are beginning to see in Kashmir a place where it is possible to settle permanently in spite of the restrictions imposed by the native Government. Already the great influx of summer visitors has caused a considerable number of Kashmiris to become servants or keepers of houseboats; a distinct impetus—not always beneficial, because it encourages the use of cheaper, less durable, dyes—has been given to the highly-developed native arts of rug-weaving, shawl-making, and embroidery; and the merchant class, though always noted for their habit of fastening on a victim, have become more rapacious than ever. Indeed, the merchants are the bane of the foreigner's life in Srinagar. They come in boats and on foot; in the guise of beggars and of princes; before sunrise, at noon, and at night; they dog one if he goes for a stroll; they sit on the bank and wait for hours to pounce upon the chance visitor. When we first tied up to the bank of the canal in Srinagar, Subhana (our factotum) suggestively laid by the door a little willow cane which might have served as a whip, and, in answer to our inquiries, remarked laconically, "For merchant." He evidently appreciated two national traits—the choleric temperament of the British officer from India and the impudent persistence of the otherwise timorous Kashmiri merchant. A typical specimen of the latter stood on the muddy shore one day as I sat on deck in the rare sunshine, and, holding up a gaudy red felt, began:

"See, master, here numda [felt] very cheap. Master buy him cheap." No reply from the traveller.

"Only look, master. No buy; only look." A pause. "You wanting other kind felt? I bringing him, very best." Still no reply.

"I good man, master, honest man. Read my letter," (holding out a well-thumbed bunch wheedled out of every foreigner whom he had ever cheated). "Only read, master. I not like other man. I good man."

"No, put them up; I don't want your felts," I answered at last.

"I got boots, master," trying a new tack. "I am leather man. I new man. I no been here before, master." He had been there an hour a day for three days, had tried to intercept us as we went to make a call, and had shouted to us from the bank as we rowed down the main canal.

Long interval broken only by such remarks as "Very good," "Cheap," "Only look," "Oh, master, look!"

At last a new effort, "What time you say I coming to-morrow morning? Eight o'clock? Very well. I bringing many shoe."

Half an hour of this sort of thing made me regret that the cane had been put away.

The problem of transportation furnishes another illustration of the influence which the invasion of Europeans in summer is having upon Kashmir. On leaving Srinagar on our way to Ladakh or Little Tibet, two hundred miles eastward across the main range of the Himalayas, we first spent a delightful spring day in floating slowly ten miles westward down the Jhelum and in being towed still more slowly seven miles northward up the tributary Sind to the head of navigation at Gunderbal. There we dismissed the houseboat; and then for two short stages shaggy little ponies, secured as a right from the villagers by means of a pass from the British Resident at Srinagar, carried us eastward up through the lovely scenery of the Sind Valley—among spreading walnut trees (often used as hay stacks), among mossy rocks, dashing brooks, and straw-thatched houses. On April 6, at an elevation of about 7,000 feet, we encountered snow too deep for horses, and were obliged for nine days to walk and have the load carried by coolies. When the first detachment of men was being procured at Gund a great uproar in the muddy courtyard called us out from our smoky, windowless room to the second-story balcony among the cows which ambitiously mount the broad stone steps. In their usual fashion, the Chief Men of the village were delaying matters because snow was falling and the road might be bad. Our headman, a remarkably trustworthy and energetic Mohammedan from Ladakh or Little Tibet, had knocked down one village official into the mud and had beaten another with a stick. Nobody seemed resentful and nobody stopped talking. Apparently they looked upon violence as the logical result of their obstructiveness; but not enjoying it, they speedily gathered the necessary band of thirty-five coolies. The latter did not want to go. Who would, if he had to carry a sixty-pound load over roads where even the unloaded "Sahib" grows weary? For six days the same band of coolies trudged through the deep snow, getting the grass sandals on their bare feet soaked with rain and slush the first day, picking their way perilously among old avalanches with new ones roaring all about them the second, burning and blistering their faces in the intense heat and dazzle of the succeeding clear day, and on the fourth, after a night in a rest-house full of smoke, tramping over the hard, smooth crust in the clear light before sunrise to the top of the Himalayan pass of Zoji La, 11,300 feet above the sea.

The men's wages, according to the official scale, were eight cents a day, except for especially hard stretches, where they got ten. As nothing is ever paid for the return journey, four or five cents a day was all that they were entitled to for the most exhausting labour; but the means of supporting life in Kashmir are so cheap that with this they were able not only to pay for their own food, chiefly bread and rice, but to support their families. In spite of their unwillingness to go, the men seemed cheerful in their stolid way, and chattered like magpies when they came in for the night. A present of a little tea all around made them quite jovial.

The bearing of burdens by coolies is a necessity if communication is to be kept up among the snowy mountains of Kashmir; but its influence is distinctly bad, encouraging brutality and violence on the part of employers and engendering deceit, laziness, and selfishness in the men-of-burden. Our coolies engaged in regular fights for the lightest loads, and some of the more clever ones constructed mock loads by wrapping a rope or some other light, bulky thing in cloth and staggering off with it. Nothing but Government compulsion could make them do the work except for exorbitant hire, although they are accustomed to carry their own loads on their backs. If the people should become more educated or more independent, they would refuse to act as coolies, and some new means of transport would be necessary. Among the changes which will in time come to Kashmir the introduction of a new system of transportation among the snowy mountains may perhaps be reckoned; for, on the one hand, education is beginning to spread, though as yet it is largely limited to the cities, and, on the other, the demand for coolie labour and the disinclination of the people to perform it are increasing with the growing invasion of Kashmir by English tourists and sportsmen.

The old order is passing away in the Vale of Kashmir, and it may not be long before the simple geographic conditions produced by the long and undisturbed residence of a homogeneous race in the seclusion of their mountain-girt basin will give place to the complexity arising from the mixture of races and the invasion of new habits and ideas. Since the opening of the new wagon-road down in Jhelum, external trade and intercourse of all kinds have received a powerful impetus; and when the projected electric railroad, run by power from the Jhelum, is completed, the isolation of Kashmir will be largely destroyed. Pronounced changes in trade, and in the distribution, habits, industries, and even character, of the natives, together with the development of a new and relatively permanent English element of population, are likely to follow; and the Kashmir of the future will be much more complex than that of the past.

PART II.—THE CLIMATE OF THE PAST.

In geographical and historical works it is generally assumed that at least as far back as the beginnings of written history, the climate of past times has been practically uniform. The basis for the assumption is largely a matter of opinion, without definite proof one way or the other. In the desert regions of northern Africa and western and central Asia, there are many places where the water supply of antiquity, as indicated by the size of ancient ruins and lakes, or by the amount of former vegetation, appears to have been greater than that of to-day. The phenomena have usually been explained on the hypothesis that the apparent decrease in the amount of water is due to human factors, such as the abandonment of irrigation works because of war, misgovernment, or disaster, the cutting off of forests, and the diversion of rivers from one region of irrigation to another. A second hypothesis holds that, even though there be no change of climate, deserts by their very nature must continually expand, eating up or corroding, as it were, the habitable areas on their borders. A third hypothesis postulates local changes of climate which affect only small areas and, so far as the hypothesis is concerned, are unrelated to each other or to any generally-known processes or events. Lastly, according to a fourth hypothesis, which I have set forth in the Reports of the Pumpelly Expedition,* and in an article recently published in the *Geographical Journal*, the climatic changes which characterized the Glacial period have continued with decreasing severity down even to the present day. Other evidence, which is shortly to be published, suggests that, while the general tendency from early historical times onward has been more or less rapidly toward greater aridity, there may have been at least one period of partial recovery during which the withering rivers of desert regions increased in volume and length, vegetation became more abundant, and the advance of deserts was checked or reversed for a time, only, however, to begin again when the climate once more tended toward aridity. Stated more concretely, but with the proviso that the statement is highly tentative, the hypothesis may be expressed as follows: The facts at hand in the drier regions of western and central Asia suggest that during the last few thousand years the climate has gradually become more arid. The general tendency toward aridity appears to have been accentuated by an unusually dry epoch somewhere in the first thousand years, more or less, of the Christian era, after which it was probably interrupted by a slight mediæval increase in humidity or cold, although at present a tendency toward aridity again seems to prevail. The inferred changes of climate are of especial significance because they seem to have coincided with and to have been the cause of some of the chief events of history.

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* Exploration in Turkestan. Publication No. 26 of the Carnegie Institution of Washington, Washington, D. C., 1905.

In the present article it is not possible to examine the four hypotheses, or any one of them, in full. I propose to investigate the question of whether there is any evidence of changes of climate in Kashmir, or whether all the facts can be explained as consistent with an unchanging climate. If the answer affirms the probability of changes, further inquiry becomes necessary in order to decide between the third and fourth hypotheses—that is, as to whether the supposed changes have been local or widespread, a question which can be answered by a study of the extent of the agreement of details in far-separated regions. Previous discussions of the climate of antiquity have dealt almost exclusively with arid regions. Kashmir, on the contrary, is a comparatively moist region, with abundant vegetation, and hence any evidence which it may present is of unusual value.

In arid regions the types of evidence upon which the hypothesis of an historic change of climate is based consist of various classes. One class, dealing with the relation of climate to life, includes, on the one hand, ruins of ancient cities and irrigation works in places where there now appears to be no sufficient water supply; and, on the other, extensive areas of dead or dying vegetation. Another class dealing with the effect of increasing aridity upon surface water, includes withering rivers and springs and enclosed lakes inferred to have decreased in size. Still a third class concerns itself with the influence of changes of climate upon the form of the earth's surface. It deals chiefly with fluviatile terraces or other deposits which happen to be so placed that it is possible to ascertain their date with reference to man. A last class consists of the type of evidence found in historic and legendary records. It is evident that in a region like Kashmir, where water and vegetation are still abundant and the rivers and lakes discharge to the sea, the first two classes of evidence can find no place. Our inquiry must be limited to a comparison of terraces and allied phenomena on the one hand with legendary and historic records on the other.

The Jhelum, which, it will be remembered, is the main river of Kashmir, and all of its chief tributaries which I saw—namely, the Kunhar, Kishen-Ganga, and Sind—wherever they flow in well-defined mountain valleys are bordered on either side by a series of fluvial terraces composed of gravel, and rising to a height of five to five hundred feet above the stream. In order to understand the relation of the terraces to the problem of the climate of the historic past, it is necessary to gain a clear conception of their cause. Hence a somewhat technical physiographic discussion is necessary before we can pass on to the human side of our subject. Three hypotheses present themselves in explanation of the terraces of Kashmir. According to one, the terraces may be due to changes in river action, due to the enlarged glaciers of the Glacial period, which scoured out the heads of the valleys so vigorously that the streams could not carry away all the detritus. Hence the bottoms of the valleys were filled with the detritus in the form of deposits of gravel. When the glaciers retired, and the load of the streams was correspondingly lessened, the rivers were able to cut into the gravel deposits in the bottom of their valleys and thus to form terraces. A second hypothesis attributes the terraces to warping of the earth's crust, whereby the streams were at first retarded and caused to aggrade their beds by covering them deeply with gravel and silt, and later were accelerated and induced to deepen their channels and form terraces. These two hypotheses are familiar to all students of physiography. In "Explorations in Turkestan" I have presented a third hypothesis, to the effect that the terraces are due to the changes of climate which gave rise to the Glacial period, although glaciers *per se* had nothing to do with the matter. As the hypothesis is not yet familiar to most readers, and as it appears to fit the facts in Kashmir, I shall devote a few paragraphs to its elucidation after showing why the other two hypotheses are inadequate.

The accompanying sketch (Fig. 1) represents the profile of the Jhelum river from near its head, *A*, in the middle range of the Himalayas, across the plain of Kashmir, through the Wular lake, and across the front range of the Himalayas, *C*, to the plains of northern India. The unshaded portion represents the solid rock below the bed of the river. The heavily shaded portion represents deposits of gravel which have been dissected into a terrace; and the lightly shaded upper portion represents the mountains through which the gorges of the Jhelum are cut at *A* and *C*, and which surround the plain of Kashmir. Although the upper surface, that is, the smooth top, of a given terrace on any of the observed rivers of Kashmir descends steadily, as shown in the profile, its height above the stream varies, being greater where the valley sides rise steeply to a great height, as at *A* and *C*, becoming less as the mountains diminish in height and steepness, and being reduced almost or completely to nothing in flat plains, such as that at Kashmir, *B*, where the mountains retire far from the river. If the terraces were due to the erosive activity of glaciers, they, that is the terraces, would be highest at the head of the valley, *A*, close to the glacial source of their component gravels. They would diminish in height downstream toward the plain, *B*; but they could not revive again in the lower range, *C*, where there have never been any glaciers competent to supply the required rock waste or gravel. Hence we conclude that the variation in the height of the terraces above the stream in response to the character of the valley sides, involving their revival to great size after having been reduced almost to nothing, shows that they cannot be due to any cause such as glaciation acting at the head of the valley, *A*, but not among the lower mountains surrounding *C*.

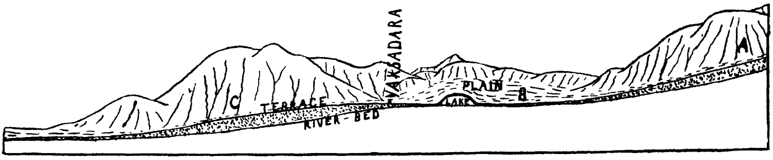

FIG. I—IDEAL LONGITUDINAL SECTION OF THE JHELUM VALLEY.

The possibility that the terraces are due to warping of the earth's crust is not absolutely excluded by the facts at Kashmir, so far as I saw them. It is rendered improbable, however, by the fact that terraces of the same relative size and order are found on independent streams flowing in opposite directions down either side of both the front and main ranges of the Himalayas, and on streams such as the Jhelum and Indus, which flow southward across one or both ranges. If the terraces are due to warping, it means that during the most recent geological times both ranges for a distance of hundreds of miles must have been subject to small up-and-down movements which preserved the same relative intervals and intensity over the entire area. Such a supposition is contrary to the very local and variable character of earth movements now taking place—for instance, the San Francisco earthquake, where the intensity of the dislocation and even the direction varied from place to place. Moreover, earth movements of the past recorded in faults, or dislocations of the earth's crust, usually appear to have involved motion chiefly in one direction, rather than repeatedly up and then down, as must have been the case if such movements are responsible for the alternate cutting and filling seen somewhat among the Himalayas, and still more in remoter regions, where, most significantly, the terraces are almost identical with those of Kashmir.

If we are right in concluding that the terraces cannot be due either to glacial action, or to warping of the earth's crust, the only alternative appears to be that they are due to changes of climate. Such an hypothesis is supported by the uniformity of the terrace phenomena over vast areas. In Persia, Transcaspia, and Russian Turkestan, as I have shown in the reports of the Pumpelly Expedition, the terraces of the main valleys leading from the higher mountains present a marked degree of uniformity in structure, arrangement, number, appearance, and relative size. In north-western India and in Chinese Turkestan, both among the Kuen Lun Mountains on the south and the Tian Shan Mountains on the north, the same is true. From Persia on the west to China on the east the typical series of terraces consists of three which are old and large and comparatively dissected, two which are much smaller, younger and better preserved, and a still smaller one, often absent, which may be called incipient. Sometimes there are traces of one or two terraces older than any of those just mentioned.

We are apt to think of the Glacial period as, primarily, a time of intense glaciation. Such a view is inadequate. Glaciation was a phenomenon whose distribution in space was limited to the northern half of Europe and North America, and to a few elevated regions in other parts of the world. Its distribution in time was limited to the five or more glacial *epochs* which formed half of the Glacial *period*, the other half being composed of *inter*glacial epochs, during which the climate was so far ameliorated that the glaciers retired as far as their present position, or farther. Thus the Glacial period was, primarily, a time of *climatic change.* It consisted of alternating epochs of colder or moister climate on the one hand and of warmer or drier climate on the other. In non-glaciated regions one of the most notable features of the colder or moister epochs must have been an increase in the size of rivers analogous to the increase in the size of glaciers in glaciated regions. Hence, such epochs may fitly be termed "fluvial" when we speak of regions where rivers increased in size, just as they are called "glacial" in regions where glaciers increased in size. The use of the word "fluvial" is advisable in order to avoid the implication of glaciation involved in the more common word. Accordingly, when referring to non-glaciated regions I shall use the terms "fluvial" and "inter-fluvial" and their derivatives as the designations of the contrasted climatic epochs ordinarily known as "glacial" and "interglacial" in Europe and America. The new terms imply nothing as to the cause of the epochs under discussion. The exact cause of the Fluvio-Glacial period is as yet unknown. It may have been due to alternating conditions of relative cold and heat or of increased and decreased precipitation, or of more or less cloudiness, or to a combination of any two or all of these possibilities. In using such terms as moist, cold, humid, dry, warm, arid, and the like, I do not mean to imply anything one way or the other as to the cause of the Fluvio-Glacial period.

Whatever the cause of "fluviation" may have been, it seems safe to say that in non-glaciated regions, such as most of Central and Western Asia, a fluvial epoch was a time of increased humidity, because of either increased precipitation or a diminished evaporation. In either case the size of rivers, springs, and enclosed lakes would increase, and the soil would be more damp than in an inter-fluvial epoch such as the present. Under such conditions the processes of weathering or rock decomposition would be more active. Therefore, in places where the underlying rock was not already protected by a thick layer of soil, weathering would proceed rapidly until such a layer was formed. In regions which are now arid this would be especially true. Under conditions of aridity, plants are so scarce that the soil is not held in place, even on very gentle slopes. It is washed away by occasional torrential rains almost as fast as it is formed. Increased humidity would cause an increased growth of vegetation, the roots of which would be effective agents in holding in place the new soil and half-decomposed rock produced by the more rapid weathering.

One objection must be met at this point. There can be but little doubt that fluvial conditions would cause a deeper accumulation of soil in regions which are now warm as well as dry. It is conceivable, however, that in regions which are now *cold* and dry, the possibly increased degree of cold might diminish the amount of vegetation so that the thickness of the cover of soil would grow less rather than increase. In certain places this might occur, but not often. Botanists agree that lack of water is far more injurious to plant growth than is lack of heat. The dependence of vegetation upon favourable conditions of moisture rather than of temperature is well illustrated by a comparison of two regions which I saw in Central Asia. The western part of the Tian Shan Mountains in the vicinity of Son Kul (left-hand lake) lies in latitude 42°, eight degrees north of Ladakh in the Himalayas.

Both regions lie at the same altitude of 10,000 to 11,000 feet; and if the moister parts of Ladakh, such as the Dras Valley north of Kashmir, be included, the precipitation is not widely different. But Son Kul is a cold place, where snow lasts eight or nine months, and there are frosts in July; while most of Ladakh has snow for scarcely three months, and is so warm that apricots can be raised, and snow remains for scarcely three months. Yet, when I visited Son Kul as a member of the Pumpelly Expedition, I found that because of the low temperature there was but little evaporation and the ground was very moist. Consequently the mountain slopes in July were covered with a thick protective growth of turfy grass, full of the most delicate spring flowers and dotted with scores of the felt tents of nomadic Kirghiz and with literally thousands of cattle and sheep. As might be expected, the soil, thus protected and held in place, was deep. In Ladakh, on the contrary, in May, as is true throughout the year, the dry, hot slopes were almost naked, and the few sheep of the hardy villagers were browsing on scattered burtse and other sparse plants of the sage type. The disparity between the two places, both as to vegetation and soil, was out of all proportion to the disparity in precipitation. If Ladakh were to become as cold as Son Kul, there would be much less evaporation, and the vegetation would approximate to that of Son Kul. Naturally, an increase of precipitation would cause a similar result. Thus, except in extremely cold regions, a fluvial epoch, whether due to greater cold or greater precipitation, would be a time of more abundant vegetation, which would hold the soil in place.

Let us suppose now that during a fluvial epoch a mountainous country, more or less arid, as the case may be, has become somewhat thickly covered with soil. If now an interfluvial epoch should ensue, there would be an approach toward aridity, even though conditions might not be extreme. Part of the vegetation would gradually disappear, and the tendency to sudden and violent floods would increase. Consequently, the soil and rock fragments covering the mountain slopes would be more exposed to erosion and would be washed down to the valley bottoms. The amount of material thus provided would be so large that the streams would be overloaded and could not carry it all away. Thus the valley bottoms would become areas of deposition. In time, however, the slopes would be stripped of all loose material, or else an epoch of greater humidity would again prevail, and vegetation would increase so as to check the carrying away of the soil. In either case the streams would not have so heavy a load of detritus as formerly, and would begin to cut into the deposits of relatively loose material at the bottoms of their valleys, thus forming terraces. By repeating the processes of deposition and erosion, an indefinite number of terraces might be formed, provided each repetition was less effective than its predecessor, whose work it would otherwise conceal.

The theory which has just been outlined must now be applied to Kashmir. In the gorges of the Jhelum a complete series of terraces is developed. In the plain, however, the two lower terraces are rudimentary or lacking; while the upper ones take the form of "karevas," the long tabular slopes of gravel mentioned in the general description of Kashmir. Their structure is illustrated in Fig. 2, an ideal section across the plain from north-east to south-west. Apparently, at the end of one of the main fluvial epochs, when much loose soil and broken rock had accumulated on the mountains, a more arid interfluvial epoch with a fairly dry summer climate like that of to-day ensued, causing vegetation to diminish somewhat and allowing the weathered mantle of rock to be washed down to the plain, the level of which was thus raised to 1 (Fig. 2). During a succeeding epoch; part of the material thus deposited was cut away by the river, leaving a "kareva," *A*. Probably the process was repeated several times, for in various places, there are traces of three terraces, as we saw on the spur at Baramula, or at Srinagar on the isolated temple-crowned hill of the Takht-i-Suliman (Throne of Solomon), a thousand feet high.

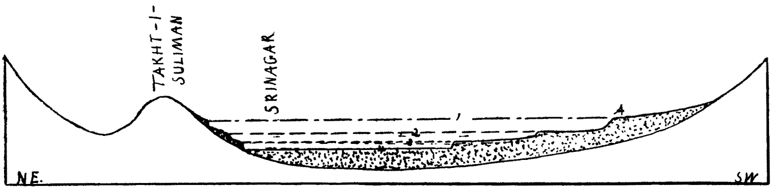

FIG. 2.—IDEAL CROSS-SECTION OF THE KASHMIR PLAIN, SHOWING ITS CHARACTER AS A BASIN PARTLY FILLED WITH FLUVIATILE DEPOSITS, AND ALSO THE KAREVAS, OR TERRACES.

On the side of the Takht-i-Suliman, as appears on the left of figure 2, the terraces are mere remnants, the narrow, steeply-sloping would be washed down to the valley bottoms. The amount of material thus provided would be so large that the streams would be overloaded and could not carry it all away. Thus the valley bottoms would become areas of deposition. In time, however, the slopes would be stripped of all loose material, or else an epoch of greater humidity would again prevail, and vegetation would increase so as to check the carrying away of the soil. In either case the streams would not have so heavy a load of detritus as formerly, and would begin to cut into the deposits of relatively loose material at the bottoms of their valleys, thus forming terraces. By repeating the processes of deposition and erosion, an indefinite number of terraces might be formed, provided each repetition was less effective than its predecessor, whose work it would otherwise conceal.

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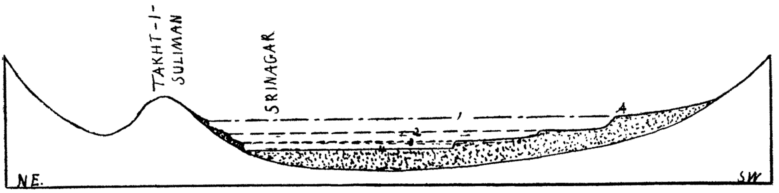

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On the side of the Takht-i-Suliman, as appears on the left of figure 2, the terraces are mere remnants, the narrow, steeply-sloping six summer months, and withdrew to warmer regions each winter, leaving Kashmir during the cold season to the Pisacas, the vilest and most malignant of Hindu demons. At length, however, after four yugas or ages the Brahman Caandradera learned certain rites which freed the country from the Pisacas and from excessive cold; and Kashmir became habitable throughout the year. Stein (1899, p. 66) and Drew (p. 207), two of the most careful writers on Kashmir, regard this tradition as not founded on historical fact, but on inference from the lake-like appearance of the basin and from the fact that during floods Lake Wular is subject to considerable fluctuations in size. It is possible that the legend of an ancient lake, drained by the ploughshare of a god, might rise in this way, but there is nothing in the physical features of Kashmir to give rise to the circumstantial details of the great cold of antiquity, the long prevalence of winter, the occupation of the country by nomads at first during only half the year, and its later change to conditions adapted to agriculture. The circumstantial character of the legend and the agreement of the details with physiographic facts in Kashmir and elsewhere, as will shortly appear, give ground for supposing that the story may be founded on fact.

Another legend, also quoted by Stein (1899, p. 115), relates how, after the drying up of the lake, the site was occupied by a town called Candrapura. A certain holy man coming to the town and being refused entertainment, cursed it and foretold its destruction by water. Later a fountain-god, who visited the country in the guise of an old Brahman, asked and obtained permission to settle in the town, and then out of gratitude revealed himself in his true form and warned the king of the prospective submersion of the city. The king and his people accordingly migrated a short distance westward and, under the god's direction, founded a new town. Then the god took up his residence in the lake, which soon overwhelmed the old city. The natives say that ruins, supposed to be those of this city, have been seen at the bottom of this lake.

Turning now from legend to better-attested history, it appears that Kashmir, now and always, has suffered more or less from famine, due, not to drought, as in so many countries, but to floods, which drown the rice crop. In the time of King Avantivarman, A D. 855–883, as Stein (1899, p. 108–109), on the authority of Kalahana, relates, Kashmir had long been suffering from peculiarly disastrous floods of this sort and from the general water-logged condition of the country. Many attempts had been made to mend matters, and at last, to quote Stein, "Suyya, a man of conspicuous talents but low origin, offered to remedy the troubles. The operations commenced at Yaksadara, where large rocks, which had rolled down from the mountains lining both river-banks, obstructed the Vitasta (Jhelum). . . . Yaksadara, the present Dyaragul, is a spur projecting into the river-bed some three miles below the commencement of the Baramula gorge. Its rocky foot forms the first rapid of the river (after it leaves the Kashmir plain). By removing the obstructing rocks the level of the river was lowered. Then a stone dam was constructed across the bed of the river, and the latter thus blocked up completely for seven days. During this time the river-bed was cleared at the bottom, and stone walls constructed to protect it against rocks which might roll down. The dam was then removed, and the river flowed forth with increased rapidity through the cleared passage: I must leave it to competent engineering opinion to decide to what extent and at which point of the Baramula gorge the operations so far described were practicable with the technical skill of that age. What follows in Kalhana's account is so matter-of-fact, and so accurate in topographical points, that a presumption is raised as to the previous statements, also resting, partially at least, on historical facts."

Yaksadara, where the operations were carried on, lies directly opposite the mouth of a large stream which, in the ten miles from its source near Gulmarg, descends 7,000 feet. It appears as though, at the time of Avantivarman, the large fan of this stream had encroached upon the Jhelum and raised its level, just as has happened at many other places lower down—for instance, at Uri, where the front of the fan was in later times cut off by the river. The process of cutting off the front of the Yaksadara fan, though begun artificially under the direction of Suyya, probably continued naturally during later centuries; for the level of the Wular Lake appears to have fallen steadily, as though the river were slowly deepening its channel by cutting away the fans and other material in the bottom of its valley, thus forming a terrace. In proof of this fall of the lake level Stein (1899, p. 113) cites certain villages which Kalhana, 1148 A.D., seems to indicate as having been actually reclaimed from the lake, and which Jonajara, *circa* 1450 A.D., still places on its very edge, although now they are three miles from its border. Similarly, Srivara, *circa* 1480 A.D., speaking of the neighbouring villages stretching from Sudarkoth (Sadykoot) to Andarkoth (Andykoot), seems to place them along the shore of the lake, although they are now from four to six miles away. Stein attributes the change in the relation of the villages to the lake to the building up of the delta of the Jhelum, where it enters Lake Wular. This cause, however, though doubtless operative, seems inadequate to produce such great results, especially when it is considered that some of the marshy regions to the south of the lake away from the delta have also become drier. The chief cause is probably the lowering of the level of the lake by the deepening of the outlet channel—a process which has surely taken place not many centuries ago, as is proved by the freshness of that which Stein (1899, p. 116) calls the "winding but well-defined bed" which the river has cut in recent times—and is, perhaps, still deepening—from the outlet of the lake to the head of the gorge.

Putting aside all unnecessary details, the following outline of events appears to fit the legends and facts related in the last few paragraphs. Long ago, in prehistoric times, the basin of Kashmir contained a lake much larger than that of to-day. The lake was partially drained by the deepening of the channel at the head of the gorge of Baramula, where, it should be remembered, the river would encounter only unconsolidated deposits. After this, or at this very time, the climate was so cold, or the winter snows were so abundant and lasted so long, that the country could be inhabited only in summer by nomads who migrated southward in winter. In time, however, the climate moderated, and Kashmir became the abode of a permanent and prosperous agricultural community. At the height of its prosperity a new difficulty appeared. By reason of the building up of the bottom of the gorge near Baramula. the lake began to expand again, and to overwhelm inhabited villages. Many attempts were made to remedy matters, and success was finally attained, after which the river itself was able to deepen its channel, instead of letting itself be checked by the waste brought in by its tributaries.

The size of the legendary lake of the earliest tradition suggests at first thought that the water supply then was larger than at present. According to the theory of terraces, already outlined, however, this is not necessarily the case; the lake would be most likely to expand in a dry epoch. It is not a question of water supply, as in the case of salt lakes in enclosed basins, but simply of how the Jhelum River came to be so checked that a small portion of its superabundant water was detained in a lake. At present Wular Lake is about twelve miles long north and south by about six east and west, and, according to Stein, has a maximum depth of fifteen feet. It is surrounded on all sides by alluvial deposits, which have been built up in such a way as to leave at the base of the northern mountains the faint hollow in which the lake lies. The formation of the broad dam, so to speak, which holds back the lake, may probably be attributed, in part to the deposits laid down during seasons of flood by the Jhelum itself, and still more to the deposition of fans by the tributaries which come in from the north and south near the mouth of the Baramula gorge. In a slightly moister epoch the forces of erosion would be less active upon the mountain slopes, because of their thicker cover of vegetation ; the streams, though large, would not be very heavily loaded, and the tendency would be to cut away the fans and similar deposits which had previously been laid down and to drain the lake. On the advent of a drier epoch, on the other hand, the forces of erosion would be more active upon the mountain slopes, and the average size of the fragments carried away would be greater because of the diminution in vegetation and in the number of roots which would hold the soil in place; the streams, especially the shorter, steeper tributaries, would be not only more heavily loaded, but also smaller; and the valley bottoms, with their comparatively gentle slopes, would become areas of deposition. Where the swifter tributaries joined the slower main stream they would tend to build up fans which the main stream, also diminished in volume and more heavily loaded, might not be able to remove. Thus the fans would form dams ; and, paradoxical as it may seem, lakes would tend to be formed in drier epochs and to be drained in moister epochs. The process would be simply another phase of the terrace-making process already discussed.

If now our conclusions as to terraces and lakes, on the one hand, and the physical history of Kashmir, as inferred from legend and history, on the other, be compared with the interrupted progress of desiccation suggested by the facts in remoter regions, it will be seen that the three lines of evidence agree quite closely. The terraces seem to indicate a succession of climatic oscillations, during the drier phases of which the basin of Kashmir was probably occupied by a large lake which was drained during the moister phases. No absolute proof of such a lake has been found, however; for though Drew and others have thought that the "karevas" —the tabular deposits of silt and gravel already discussed—were lacustrine, recent investigation in other regions has shown that such deposits are usually largely of fluvial origin, though small lacustrine portions are not uncommon. The earliest legend demands a large lake; physiography gives no direct evidence of such a lake, but says that there is a high degree of probability that something of the sort may have been formed during a dry epoch. Hence we may provisionally accept the hypothesis that during the last interglacial or interfluvial epoch of comparative dryness a lake was formed which persisted long enough to be seen by early man.

Evidence as to the succeeding epoch is more definite and more completely in agreement. The legend points to a cold period during which Kashmir was not habitable in winter, and during which the lake which occupied the plain was drained by the cutting of a deeper channel. Physiographic evidence, as we have seen in the discussion of the paradoxical origin of lakes, seems to show that if there were a lake larger than that of to-day, it was probably drained during one of the moist epochs of which the terraces furnish independent evidence. In Transcaspia, Persia, and Turkestan, other lines of research give ground for the hypothesis that two thousand or more years ago the water supply was decidedly larger than now, and the desert regions were more habitable. Putting together all these conclusions, there seems to be reason for believing that a fluvial epoch, culminating somewhere in remote antiquity, had not yet wholly passed away at the beginning of the Christian era, and may have been the time indicated in the legend when Kashmir was too cold to be inhabited, except in summer, by nomads. Even to-day the snowfall of Kashmir is so great that agriculture cannot be carried on at an elevation of much over 7,000 feet, and on the plain itself, at an elevation of from 5,000 to 6,000 feet, early snows sometimes cause disaster by destroying the rice crop. It would need but a slight increase in cold or in snowfall to render the whole country unfit for agriculture and only habitable for nomadic shepherds, who would drive their flocks southward in winter, away from the snow, to the warm, low plain beyond the mountains; and such we may reasonably believe to have been the condition of Kashmir before it appears in history near the opening of the Christian era.

By the sixth or seventh centuries of that era, as history shows, Kashmir had acquired nearly its present prosperous character, and not long after was suffering from the filling of the channel of the Jhelum with detritus from the mountains and the consequent expansion of the lakes. Such prosperity and such disaster would naturally result from a relatively dry or warm epoch such as that which is supposed to have accentuated the general tendency toward aridity during the first six or eight centuries of the Christian era. On the one hand, agriculture would be stimulated, and, on the other, fans of boulders and gravel would be deposited in the river bed, causing the lake to rise, and perhaps to submerge villages.

As to the possible succeeding mediæval interruption of the tendency toward aridity there is little to be said. The deepening of the channel of the Jhelum, and the slight lowering of the level of the Wular Lake are the results to be expected under such circumstances, as are also the famines, which Stein (1899, p. 119), on the authority of Kalhana, describes as taking place in the twelfth century because of prematurely early snowfalls. Similarly the complete freezing over of the Jhelum, described by Kalhana in 1087–8 A. D., and the extreme isolation of Kashmir during the Middle Ages, would be natural if the winters were more severe and the passes more snowy than now.

Altogether, the human history of Kashmir shows a fairly close agreement with the physical history as inferred from the terraces and from their relation to those of other regions. The evidence thus far discovered affords some slight but most interesting indications of the possibility of an acceleration of the process of desiccation during the first part of the Christian era, and of a reversal of the process during the succeeding mediæval ages. Its chief importance, however, lies in the fact that here, in the fairly moist region of Kashmir, in India, south of the main range of the Himalayas, just as in the arid regions far to the west, north, and east, there are somewhat distinct indications that desiccation has actually taken place—that is, that there has been a transition from colder or damper climatic conditions, two thousand or more years ago, to warmer or drier conditions to-day. The transition appears to be part of a widespread change of climate presenting the same general features as the more intense fluvial or glacial epochs of earlier times, and extending at least from Persia and the Caspian Sea on the west to the borders of China proper, three thousand miles away, on the east. In Kashmir, at least, the change seems to have had a notable effect upon the habits and distribution of man, and thus upon his whole development.